Public Research and Innovation Funding Actors in Canada

STINT
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Preface

The mission of the Swedish Foundation for International Cooperation in Research and Higher Education (STINT) is to internationalise Swedish higher education and research. STINT promotes knowledge and competence development within internationalisation and invests in internationalisation projects proposed by researchers, educators and leaderships at Swedish universities. STINT's geographic focus is on countries outside Europe.

In 2019, we extended our activities abroad by establishing a presence in North America as a complement to our office opened in China in 2018. In order to further promote academic partnerships with a continent that is in many ways at the research front, and to increase understanding of the knowledge systems of Canada and the USA, Dr Niklas Z Kviselius was appointed STINT's representative in North America. The aim of this initiative is to support Swedish HEIs' strategies, activities and networks in relation to North America through contributing knowledge and skills to Swedish HEIs and research funders on developments in higher education and research in Canada and the USA.

In Canada, there are clear indications of a strengthening of the research and innovation system, with increased investments in both basic and applied research. One stated aim is diversification, with Canada looking for new international research partnerships. The aim of this report is to spur an interest in international collaboration based on the strengths and challenges Canadian research funding actors have identified and are working on. Robust international collaboration starts with an understanding of the needs and wants of both parties, so that strengths can be amplified and weaknesses mitigated. Further discussion is welcomed as to the evolving opportunities Sweden can identify in collaboration with Canada.

This report is by no means a comprehensive mapping of the complex research funding landscape in Canada. Emphasis is on giving an outside observer and potential future collaboration partner some familiarity with the Canadian system, rather than to critically analyse each actor's strengths and weaknesses. Key federal actors are introduced, as well as some of the most influential provincial actors in four major provinces. The current focus of and public sector direction for the Canadian science and innovation system is laid out, and recent trends are presented, based on budgeting.

The author of this report is Dr Niklas Z Kviselius, Representative in North America, STINT.

Andreas Göthenberg
Executive Director, STINT

Stockholm, May 2020

Executive Summary

Canada, a young federation of independent provinces

Together, Canada's provinces collect more revenue than the federal government based in the capital of Ottawa, an almost unique structure among federations in the world. Despite an overarching federal funding system for research and innovation, each province is independent regarding the thematic areas and additional support to certain institutions and whole industries it provides. Because of the interplay between federal, provincial, and municipal levels, a Canadian researcher or entrepreneur looking to fund research or innovation initiatives must try to stay informed about opportunities stemming from all three layers. At the same time, one must pay close attention to federal laws and permits as well as provincial and local legislation. These can and do differ; privacy and data storage are handled differently across Canada, for example. The same understanding is equally beneficial for a Swedish funding agency or individual researcher or company engaging with Canada.

Four provinces constitute the bulk of Canada's population and economic activity

Four provinces have been included in this mapping: British Columbia, Alberta, Ontario and Quebec. These provinces are not only the largest of Canada's provinces geographically speaking, but also the most the most populous – together they account for 86% of the country's population – and with the highest concentration of economic activity. This report gives an overview of the provincial governance of research and innovation and some important actors in the funding ecosystems of these four provinces.

Large reliance on the primary sector

Canada's economy is the tenth largest in the world, relying chiefly upon its abundant natural resources in combination with well-developed international trade networks. Canada is unusual among developed countries in the importance of its primary sector, of which the forestry and petroleum industries are two of the most prominent components. There are clear opportunities to advance in the global value chains by further refining and combining primary resources before export, and continuing building a knowledge economy on this foundation. Sweden has made this journey in several industries, supported by our robust research and innovation system, and should have much to offer Canada as to innovation policy comparisons.

Ethnically diverse and multicultural – in the shadow of the US

Canada has one of the highest per-capita immigration rates in the world, driven mainly by economic policy. It is one of the world's most ethnically diverse and multicultural nations, the product of large-scale immigration from many other countries. A primarily skills-based immigration policy has benefitted the academic sector. Canada's long and complex relationship with the United States has had a significant impact on its economy and culture. Canada ranks among the highest in international measurements of government transparency, civil liberties, quality of life, economic freedom, and education.

A medium-sized science, technology and innovation nation with ambition

Accounting for more than CAN$ 30 billion in R&D spending every year, science, technology and innovation is a priority at all levels of Canadian government, as well as in industry and academic institutions. Business accounts for half of the R&D activities undertaken in Canada, followed by higher education institutions with about 40%, the federal and provincial governments with about 8%, and private nonprofit organisations with most of the remainder.

Canada's relative position in the global research and innovation landscape places the country in the middle of playing field. Compared to European spending on research and the number of researchers, Canada resembles a somewhat smaller version of Great Britain – or is slightly larger than the Netherlands. Outside Europe, Australia is a similar country regarding position and spending. Canada is furthermore home to the most educated talent pool of all OECD countries.

Canada reversed stagnation in government funding for research and innovation

Both the 2018 and 2019 federal budgets of the Liberal government focused strongly on skills development and the future of work and included substantial investments in science and research. This is a clear break in the last two decades' trend of general stagnation in federal research funding, and the budgets were received well by the research community.

Streamlined leadership and governance for funding while striving for better coordination

This revamp is not only executed via increased federal funding, but also by putting research and innovation firmly on the national agenda and streamlining the leadership and governance structure. Examples of initiatives include the new position of a Chief Science Advisor to provide advice on science to the Prime Minister, as well as a new Council on Science and Innovation to replace the former Science, Technology and Innovation Council to coordinate the federal granting councils and improve overall coordination across the federal funding ecosystem.

Focus on research and innovation in five broad areas

When looking at the 2018 and 2019 National Budgets for Science and Innovation, five broad areas emerge as both current strengths and emphases for further development: 1. Environment and agriculture; 2. Health and life sciences; 3. Information and communications technologies; 4. Natural Resources and Energy; and 5. Advanced manufacturing. These are the areas Swedish actors should relate to when engaging Canada on partnerships.

National research and innovation portfolio primarily managed by the Minister of Innovation, Science, and Industry, and the Department for Innovation, Science and Economic Development Canada (ISED)

In understanding the Canadian system for funding research and innovation, a clear focus is on the Minister of Innovation, Science, and Industry, and the Department for Innovation, Science and Economic Development Canada (ISED). The Minister of Innovation, Science, and Industry runs the Innovation, Science and Economic Development Portfolio via the Department for Innovation, Science and Economic Development Canada (ISED). However, there are departments and agencies that fund research under the portfolios of several other ministers. Most notable is the Canadian Institutes of Health Research (CIHR) that report to the Minister of Health; funding can also come directly from a ministry as in the case of the ministry Natural Resources Canada (NRCan) for research on energy.

Tri-Agency structure the major source of research funding for post-secondary institutions across Canada

The main sources of Canadian federal research funding are three agencies known as the Tri-Agencies:

- Canadian Institutes of Health Research (CIHR)
- Natural Sciences and Engineering Research Council (NSERC)
- Social Sciences and Humanities Research Council (SSHRC)

Overall Landscape

Basics

Canada is a young federation of independent provinces

By European standards, Canada is a young country. Canada's post-war economic growth, combined with the policies of successive Liberal governments, led to the emergence of a new Canadian identity, marked by the adoption of the Maple Leaf flag in 1965 and the implementation of official bilingualism (English and French) in 1969. Socially democratic programmes were also instituted, such as Medicare, the Canada Pension Plan, and Canada Student Loans. Canada has one of the highest per-capita immigration rates in the world, driven mainly by its economic policy, and a growing population. About 90% of the population of 37 million live within 160 km of the border with the contiguous United States (Government of Canada (2020)).

Canada has a parliamentary system within the context of a constitutional monarchy – the reigning British monarch is also monarch of fifteen other Commonwealth countries and each of Canada's ten provinces and three territories. The major difference between a Canadian province and a territory is that provinces receive their power and authority from the Constitution Act, 1867 (formerly called the British North America Act), whereas territorial governments have powers delegated to them by the Parliament of Canada. Provinces enjoy more autonomy than territories, having responsibility for social programmes such as healthcare, education, and welfare. Together, the provinces collect more revenue than the federal government based in the capital of Ottawa, an almost unique structure among federations in the world. John A. Macdonald, Canada's first prime minister, originally favoured a unitary system; later, after witnessing the carnage of the American Civil War, he supported a federal system to avoid similar violent conflicts (Parliament of Canada (2020)).

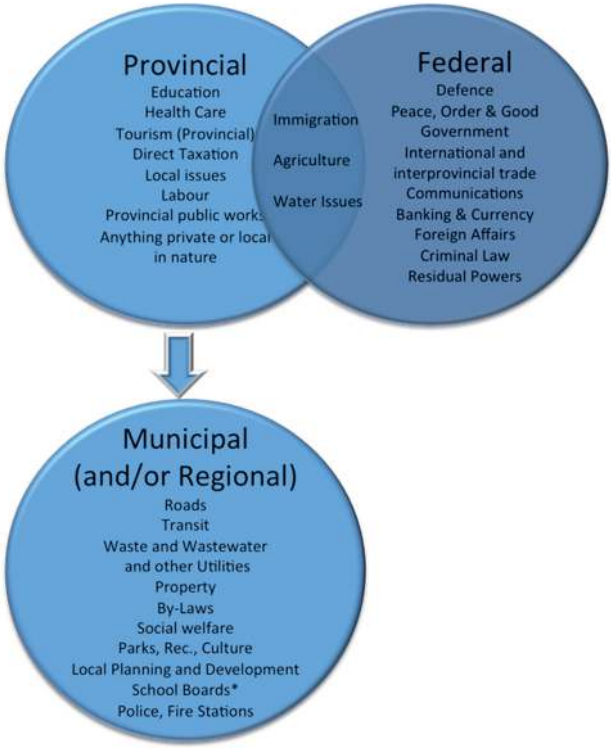

Figure 1: **Federal-Provincial-Municipal division of responsibilities. Source: FromEhtoZ(ed) (2014)**

One implication of this federal structure is the opportunity for provinces and to some extent cities to concentrate efforts and advantage, also legislatively, certain industries or types of research they want to favour. One example is new legislation in Ontario allowing a wide array of automation and automated vehicles, while in the rest of Canada this is strictly prohibited. Because of the interplay between federal, provincial, and municipal levels, a Canadian researcher or entrepreneur looking to fund research or innovation initiatives must try to stay informed about opportunities stemming from all three layers. At the same time, one must pay strict attention to federal laws and permits as well as provincial and local legislation. These can and do differ; privacy and data storage are handled differently across Canada, for example. The same understanding is equally beneficial for a Swedish funding agency or individual researcher or company engaging with Canada.

Large reliance on the primary sector

Canada's economy is the tenth largest in the world, relying chiefly upon its abundant natural resources in combination with well-developed international trade networks. Canada is unusual among developed countries in the importance of its primary sector, of which the forestry and petroleum industries are two of the most prominent components. Canada is additionally one of the world's largest suppliers of agricultural products and a leading exporter of several major metals and minerals. Canada also has a sizeable manufacturing sector centred in southern Ontario and Quebec, with automobiles and aeronautics representing particularly important industries. There are clear opportunities to advance in the global value chains, by further refining and combining primary resources before export, and continuing building a knowledge economy on this foundation. One example is the petroleum industry's advancement of standards and technologies for cleaner extraction and refinery of gas and petroleum (International Monetary Fund (2019), Statistics Canada (2019)).

Ethnically diverse and multicultural – in the shadow of the US

The country is a realm within the Commonwealth of Nations, a member of the Francophonie and is officially bilingual at the federal level. It ranks among the highest in international measurements of government transparency, civil liberties, quality of life, economic freedom, and education. It is one of the world's most ethnically diverse and multicultural nations, the product of large-scale immigration from many other countries. Canada has one of the highest per-capita immigration rates in the world, driven mainly by economic policy. Canada's long and complex relationship with the United States has had a significant impact on its economy and culture. Canada is part of several major international and intergovernmental institutions or groupings including the United Nations, NATO, the G7, the Group of Ten, the G20, the North American Free Trade Agreement and the Asia-Pacific Economic Cooperation forum.

Funding of Science and Innovation

A medium-sized science, technology and innovation nation with ambition

Accounting for more than CAN$ 30 billion in R&D spending every year, science, technology and innovation is a priority at all levels of Canadian government, as well as in industry and academic institutions. Business accounts for half of R&D activities undertaken in Canada, followed by higher education institutions with about 40%, the federal and provincial governments with about 8%, and private nonprofit organisations with most of the remainder.

According to the most recent OECD Science, Technology and Industry Scoreboard (2017):

- Canada accounted for just over 3% of the world's top 10% most-cited scientific publications in 2016, just behind Japan and France.
- Canada is among the OECD countries where government budgets for R&D have declined since 2008, falling by 9% from 2008 to 2015.
- 12% of domestic scientific documents in Canada were in the world's top 10% most cited, equal to the European Union at 12%, but behind the United States at 14%.
- Data on the international mobility of scientific authors for 2002 to 2016 show that Canada has attracted more authors than it has lost. Over the past 15 years, almost 3,000 more scientific authors entered Canada than left the country, although the outflow has increased recently.

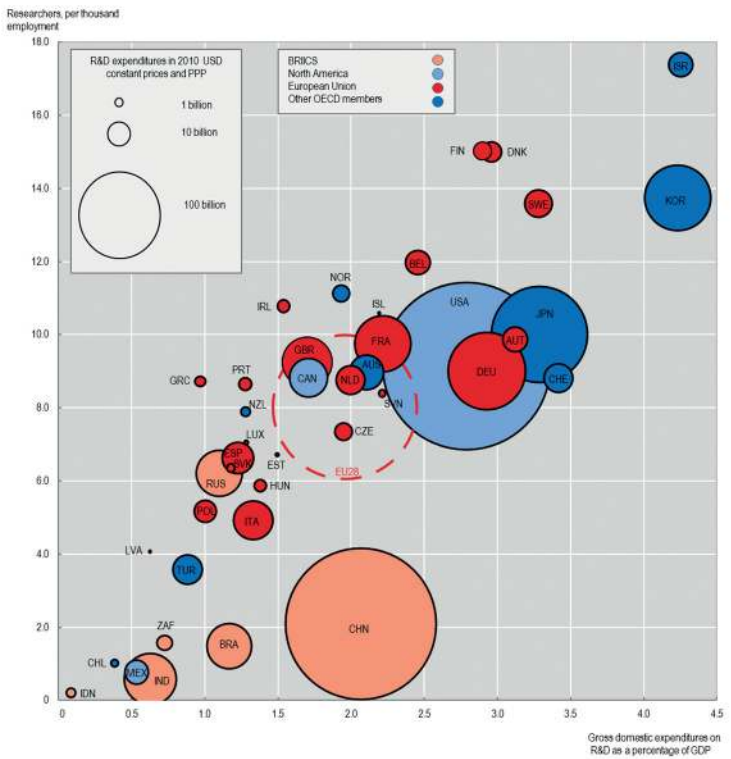

Figure 2: **R&D in OECD and key partner countries. OECD Science, Technology and Industry Scoreboard (2017)**

One way of capturing the relative position and size of R&D regarding input variables (see Figure 2) is by considering the number of researchers (y-axis) and national spending on R&D relative to GDP size (x-axis). This visual representation of Canada's position in the global science and innovation arena places the country in the middle of playing field. Compared to European spending on research and the number of researchers, Canada resembles a somewhat smaller version of Great Britain – or is slightly larger than the Netherlands. Outside Europe, Australia is a similar country regarding position and spending.

The most educated talent pool among OECD countries

More than half of its population aged 25–64 have post-secondary education, making Canada home to the most educated talent pool of all OECD countries. According to a 2019 report by the OECD, Canada is the highest educated country in the world (followed by Japan and Israel) and the country ranks first worldwide in the number of adults with tertiary education, with over 56% of Canadian adults having attained at least an undergraduate college or university degree.

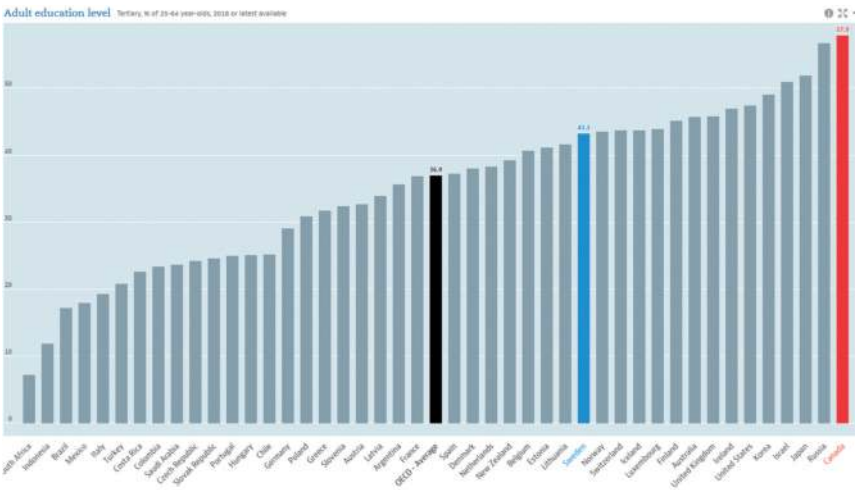

Figure 3: **Canada ranked as the OECD's most educated country. OECD Education at a Glance (2019)**

Canada spends about 5.3% of its GDP on education. The country invests heavily in tertiary education (more than US$ 20,000 per student). As of 2014, 89% of adults aged 25–64 have earned the equivalent of a high-school degree, compared to the OECD average of 75%.

Recent Major Trends in Research and Innovation

Canada reversed stagnation in government funding for research and innovation

Both the 2018 and 2019 federal budgets of the Liberal government focused strongly on skills development and the future of work and included substantial investments in science and research. This is a clear break in the last two decades' trend of general stagnation in federal research funding, and the budgets were received well by the research community.

Some prominent examples include (Government of Canada (2019)):

- CAN$ 925 million over five years to the federal funding councils;
- new funding for interdisciplinary and fast-breaking research;
- CAN$ 231.3 million over five years (CAN$ 58.8 million a year ongoing) to the Research Support Fund;
- CAN$ 763 million to the Canada Foundation for Innovation (CAN$ 462 million a year ongoing, starting in 2023);
- streamlining federal innovation programmes;
- CAN$ 210 million over five years (CAN$ 50 million a year ongoing) to the Canada Research Chairs programme;
- CAN$ 114 million over five years (with CAN$ 26.5 million per year ongoing) to the federal funding councils in new scholarship funding for master's- and doctoral-level researchers;
- CAN$ 500 million for research and science outreach organisations; and
- a planned Strategic Science Fund for funding and assessing third-party research organisations, guided by a new principle-based framework to increase transparency and accountability.

This shift in funding can be traced back to recommendations in a 2017 report, Investing in Canada's Future – Strengthening the Foundations of Canadian Research Fundamental Science Review, led by Dr David Naylor and a panel of experts (Naylor et al (2017)). This government-commissioned review took stock of Canada's fundamental science and research ecosystem, making several substantial recommendations that highlighted gaps in the ecosystem, and proposing ways to move forward in support of science and research for Canada.

The Naylor Report was commissioned in the light of a widely acknowledged stagnation of Canada's fundamental science capacity in recent years. Far from advocating a radical transformation and massive expansion in funding, the report's recommendations rather represent steps for maintaining a strong foundation of science and research to ensure all Canadians continue to benefit from its outputs.

Streamlined leadership and governance while striving for better coordination

The Naylor Report became a type of roadmap for the federal government: not only for increased funding but also for putting science and innovation firmly on the national agenda via revamping and streamlining the leadership and governance structure. Steps taken include:

- In September 2017, a Chief Science Advisor was appointed to provide advice on science to the Prime Minister and the Science Minister. The Chief Science Advisor's key functions are to provide advice on the development and implementation of guidelines to ensure that government science is fully available to the public and that federal scientists are able to speak freely about their work, provide advice on creating and implementing processes to ensure that scientific analyses are considered when the government makes decisions, assess and recommend ways to improve the existing science advisory function within the federal government, and assess and recommend ways for the government to better support quality scientific research within the federal system.
- In January 2019, the government announced a call for candidates and proposed a new Council on Science and Innovation to replace the former Science, Technology and Innovation Council.
- There have been several initiatives to improve diversity in the research community, including the made-in-Canada draft Athena-SWAN charter designed "to encourage and recognize commitments made by post-secondary institutions towards advancing equity, diversity and inclusion in the research community."

Three general macro trends are characteristic for the Canadian research and innovation funding landscape, as brought up in the 2019/2020 strategy of the influential Canada Foundation for Innovation (Canada Foundation for Innovation (2018):

1. Convergence, where a specific and compelling problem is identified that requires the deep integration of disciplines, knowledge, theories, methods, data and communities. Convergence goes beyond interdisciplinarity by bringing many fields of research together, eliminating silos and creating systematic cohesion and thinking. Convergence can also be understood in an institutional context as universities and colleges build core facilities to better manage and maximise the shared use of their infrastructures, and combine their strategic research priorities and research facilities to take on specific challenges and develop partnerships around the world. Convergence can further be understood as the deepening collaboration between researchers and research organisations in academia, the private sector, government and non-governmental organisations that share an interest in addressing social, economic and environmental challenges, fostering innovation, and improving quality of life.

2. A strong and growing emphasis on international collaboration and engagement. Across Canada, Canadian researchers and their institutions increasingly collaborate with the best in the world and engage in global research enterprises. This brings Canadian research expertise and strengths to the global stage and attracts international researchers and research organisations to Canadian institutions. Increasingly, research infrastructure is seen as the key enabling factor in developing international collaborations. The sharing of research tools, equipment and facilities draws researchers together to define and tackle a broad range of questions in areas such as astronomy, physics, environmental observation, human health, and many others. International collaboration is also being driven by the development of very large-scale research facilities; those that by the nature of their cost, scope and complexity cannot be built by one nation alone.

3. The pool of talent within Canada's research community is broadening to include a greater diversity of individuals of varied ages, backgrounds, ethnicities and genders. This greater diversity within the research community improves the quality of research by leveraging the talents of a broader range of qualified individuals and incorporating a greater variety of perspectives in the ways that research is conducted. By guaranteeing that all qualified Canadians have opportunities to build research careers, succeed in generating new knowledge and contribute to quality of life, Canadian research is ensured to meet high standards of excellence and have a meaningful impact.

Focus on science and innovation in five broad areas

When looking at the 2018 and 2019 National Budgets for Science and Innovation, five broad areas emerge as both current strengths and emphases for further development. These are the areas Swedish actors should relate to when engaging Canada on partnerships:

– Environment and agriculture

Canada is a world leader in biotechnology, air pollution control, green building and waste management. Canada is recognized globally for expertise in ocean and Arctic research. Agricultural research and innovation in Canada has led to record productivity gains and more sustainable modern agricultural practices.

– Health and life sciences

Canada has proven research strengths in areas such as genomics, bioinformatics, immunotherapy, regenerative medicine and neuroscience. Canada is a global leader in digital radiography, in-vitro diagnostics, cardiovascular devices, dental implants and materials, and home healthcare products.

– Information and communications technologies

Recognised internationally for its competitive position in mobile media, new generation networks and connected vehicles, Canada is home to well-established ICT clusters, including wireless technology, digital media and software and computer services.

– Natural Resources and Energy

Canada is the world's fifth largest energy producer and is a major hub for energy R&D. Canadian provinces lead the world in such innovative sectors as carbon capture and storage, advanced hydrogen and fuel cell technology, geothermal energy production, tidal energy technology and wind and solar energy production.

– Advanced manufacturing

Canada's manufacturing sector outpaces all other domestic industries in the introduction of process, and organisational, product and marketing innovations. Canadian manufacturers are investing in production facilities to increase agility, expand mass customisation capabilities, capitalise on market niches and optimise prototyping and new product introductions.

Federal Level – Ministers, Departments and Agencies

Each minister of the Crown – the functions of government and the civil service – is responsible for the general administration of at least one government portfolio and heads a corresponding ministry or ministries, known in Canada as departments or agencies. In 2019, there were 203 departments and agencies led by 35 cabinet members/ministers.

In understanding the Canadian system for funding research and innovation, a clear focus is on the Minister of Innovation, Science, and Industry, and the department for Innovation, Science and Economic Development Canada (ISED). The Minister of Innovation, Science, and Industry runs the Innovation, Science and Economic Development Portfolio via the Department for Innovation, Science and Economic Development Canada (ISED).

ISED is described more in detail below. However, there are departments and agencies that fund research under the portfolio of several other ministers. Most notable is the Canadian Institutes of Health Research (CIHR) reporting to the Minister of Health; funding can also come directly from a ministry as in the case of the ministry Natural Resources Canada (NRCan) for research on energy.

Innovation, Science and Economic Development Canada (ISED)

ISED is a government department mandated with fostering a growing, competitive, and knowledge-based Canadian economy. ISED covers all areas of the Canadian economy to improve conditions for investment, enhance Canada's innovation performance, increase its share of global trade, and build an efficient and competitive marketplace. ISED works together with 17 federal departments and agencies to leverage resources on innovation through science and technology, trade and investment, the growth of small and medium-sized enterprises (SMEs), and the economic growth of Canadian communities (Innovation, Science and Economic Development Canada (2020)).

Seventeen federal departments and agencies constitute the Innovation, Science and Economic Development Portfolio. Together, these organisations are uniquely positioned to further the government's goal of building a knowledge-based economy in all regions of Canada and to advance the government's jobs and growth agenda.

TISED works in partnership with the members of the Innovation, Science and Economic Development Portfolio to leverage resources and exploit synergies in a number of specific areas:

- innovation through science and technology – helping firms and not-for-profit institutions more rapidly turn ideas into new products and services;
- trade and investment – encouraging more firms in more sectors to export to more markets, and helping Canadian firms attract a larger share of foreign direct investment;
- growth of small and medium-sized enterprises – providing access to capital, information and services; and
- economic growth of Canadian communities – fostering new approaches to community economic development, based on community strengths and information infrastructures.

The Innovation, Science and Economic Development Portfolio includes the following actors:

- Atlantic Canada Opportunities Agency (ACOA)
- Business Development Bank of Canada (BDC)
- Canada Economic Development for Quebec Regions (CED)
- Canadian Northern Economic Development Agency (CanNor)
- Canadian Space Agency (CSA)
- Copyright Board Canada (CB)
- Destination Canada (DC) (formerly known as the Canadian Tourism Commission)
- Federal Economic Development Agency for Southern Ontario (FedDev Ontario)
- Federal Economic Development Initiative for Northern Ontario (FedNor)
- Innovation, Science and Economic Development Canada (ISED)
- National Research Council Canada (NRC)
- Natural Sciences and Engineering Research Council Canada (NSERC)
- Social Sciences and Humanities Research Council of Canada (SSHRC)
- Standards Council of Canada (SCC)
- Statistics Canada (StatCan)
- Western Economic Diversification Canada (WD)
- Genome Canada
- Canada Foundation for Innovation (CFI)
- Council of Canadian Academies
- Pierre Elliott Trudeau Foundation
- Sustainable Development Technology Canada (SDTC)

Some major programmes (33 in total in 2020) include:

- *Connect to Innovate:* Will invest CAN$ 500 million by 2021 to bring high-speed Internet to 300 rural and remote communities in Canada.
- *The Innovation Superclusters Initiative:* Will invest up to CAN$ 950 million 2017–2022 to support business-led innovation superclusters with the greatest potential to energise the economy and become engines of growth.
- *Innovative Solutions Canada:* A new programme with over CAN$ 100 million dedicated to supporting the scale-up and growth of Canada's innovators and entrepreneurs by letting the federal government act as a first customer. The initiative seeks technology-based solutions to federal government challenges. SMEs may receive up to CAN$ 150,000 for proof of concept projects, up to CAN$ 1 million for prototype development, and may also be awarded a government contract to support the innovation's first purchase.
- *Post-Secondary Institutions Strategic Investment Fund:* Provides up to CAN$ 2 billion for infrastructure projects at post-secondary institutions to enhance and modernise research and commercialisation facilities, as well as indus try-relevant training facilities at colleges and polytechnic institutions in Canada. The fund is a major infrastructure funding competition that seeks innovative and transformative infrastructure projects covering the full spectrum of research and development activities.
- *Strategic Innovation Fund:* Allocates repayable and non-repayable contributions to firms of all sizes across all Canadian industrial and technology sectors. The programme has a budget of CAN$ 1.26 billion over five years. It consolidates and simplifies the Strategic Aerospace and Defence Initiative, Technology Demonstration Program, Automotive Innovation Fund and Automotive Supplier Innovation Program. The programme is part of the Innovation and Skills Plan – a way to create jobs and strengthen the middle class by helping Canada's highly skilled workforce develop the skills they need to evolve and keep up with the demands of a changing workplace.
- *Genome Canada:* Acts as a catalyst for developing and applying genomics and genomic-based technologies to create economic and social benefits for Canadians. In the 2019 budget, the organisation received a five-year, CAN$ 100.5 million commitment from the Government of Canada. To gether with its six Genome Centres spread out over Canada and with other partners, Genome Canada invests in and manages large-scale research projects in key selected areas such as agriculture, environment, fisheries, forestry, health and new technology development. Genome Canada also supports research projects aimed at studying and analysing the ethical, environmental, economic, legal and social issues related to genomics research.

The Tri-Agencies and the Canada Research Chairs Program

A Tri-Agency structure provides the major source of research funding for post-secondary institutions across Canada. The main sources of Canadian federal research funding are these three agencies (collectively known as the Tri-Agencies):

– Canadian Institutes of Health Research (CIHR)
– Natural Sciences and Engineering Research Council (NSERC)
– Social Sciences and Humanities Research Council (SSHRC)

These three agencies are introduced in more detail below, but it is worth mentioning the joint programme that serves all three: the Canada Research Chairs Program (CRCP).

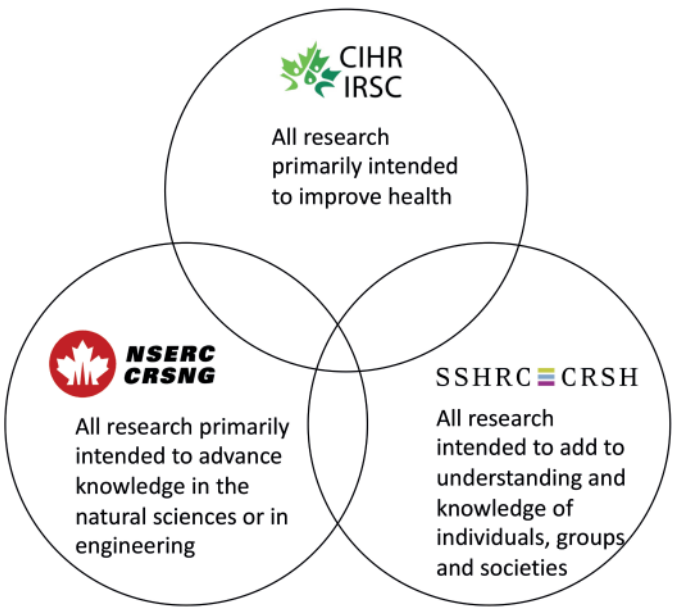

Figure 4: **Federal Tri-Agencies dominate research funding**

TCRCP is a tri-agency initiative of SSHRC, NSERC and CIHR. It is administered by the Tri-Agency Institutional Programs Secretariat, which is housed within SSHRC.

CRCP stands at the centre of a national strategy to make Canada one of the world's top five countries for research and development. In 2000, the Government of Canada created a new permanent programme to establish 2,000 research professorships – Canada Research Chairs – in universities across the country by 2008. CRCP invests CAN$ 300 million a year to attract and retain some of the world's most accomplished and promising minds. Chairholders aim to achieve research excellence in engineering, natural sciences, health sciences, humanities, and social sciences (Canada Research Chairs (2020)).

Canadian Institutes of Health Research (CIHR) – Tri-Agency

CIHR is Canada's federal funding agency for health research. Composed of thirteen Institutes, CIHR collaborates with partners and researchers to support the discoveries and innovations that improve health and strengthen the healthcare system.

Figure 5 illustrates trends in CIHR investments in various primary thematic areas, with a focus on biomedical areas.

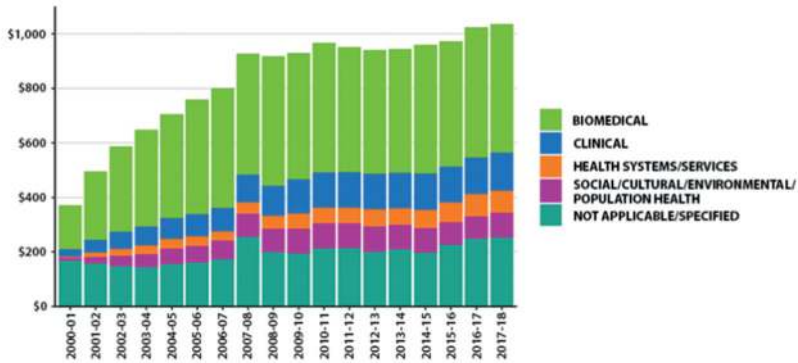

Figure 5: **CIHR Investments by primary theme years 2000-2017 (millions of dollars). CIHR Reporting 2019**

CIHR was created in 2000 under the authority of the Canadian Institutes of Health Research Act. It is an independent agency and is accountable to Parliament through the Minister of Health. CIHR's mission is to create new scientific knowledge and to enable its translation into improved health, more effective health services and products, and a strengthened Canadian healthcare system. CIHR is the largest funder of health research in Canada, supporting over 13,000 excellent researchers from all areas of health research and from all regions of Canada (Canadian Institutes of Health Research (2020)).

Figure 6 shows the growing importance of international linkages in the funding provided by CIHR, with Europe as the primary partner, and interestingly collaboration with Asia in decline since 2009.

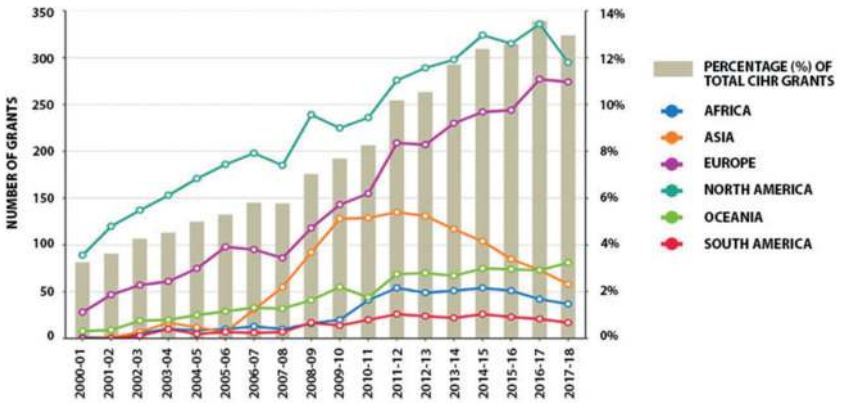

Figure 6: **CIHR international linkages years 2000-2017. CIHR Reporting 2019**

Social Sciences and Humanities Research Council (SSHRC) – Tri-Agency

ASSHRC is the federal research funding agency that promotes and supports post-secondary-based research and research training in the humanities and social sciences.

Created by an Act of the Parliament of Canada in 1977, SSHRC reports to Parliament through the Minister of Innovation, Science, and Economic Development. From April 1, 2018 to March 31, 2019, SSHRC received 14,400 funding applications and awarded more than 5,100 new grants and fellowships.

SSHRC funding opportunities are available through three programmes: *Talent, Insight and Connection.* The Talent programme supports students and postdoctoral candidates to become researchers and leaders across society, both within academia and across the public, private and not-for-profit sectors. The Insight programme is designed to build knowledge and understanding about people, societies and the world by supporting research excellence in all subject areas eligible for funding from SSHRC. The Connection programme supports specific activities and tools that facilitate the flow and exchange of research knowledge.

The research themes that SSHRC funds are diverse by nature. SSHRC published a list of Future Challenge Areas 2018–2021, which include (Social Sciences and Humanities Research Council (2020)):

- Working in the Digital Economy
- Global Health and Wellness for the 21st Century
- The Emerging Asocial Society
- Shifting Dynamic of Privilege and Marginalization
- Building Better Lives Across the Gender Spectrum
- Inhabiting Challenging Environments
- Balancing Risks and Benefits in the Emerging Surveillance Society
- Humanity+
- The Evolving Bio-Age
- Living Within Earth's Carrying Capacity
- The Pervasive Contamination of the 'Natural'
- Envisioning Governance Systems that Work
- The Changing Nature of Security and Conflict
- Truth Under Fire in a Post-Fact World

SSHRC funds more than 1,100 international researchers, representing 82 different countries, and works with 215 international partners. 41% of Partnership Development Grants involved at least one international partner, with 12% of Partnership Engagement Grants and 71% of Partnership Grants involving at least one international partner, respectively. 19% of postdoctoral fellows held their awards abroad.

Natural Science and Engineering Research Council of Canada (NSERC) – Tri-Agency

NSERC promotes research-based innovation and university-industry partnerships, supports advanced studies, discovery research, and fosters innovation by encouraging organisations to participate and invest in research projects. NSERC further connects researchers with key private and public stakeholders.

NSERC is a departmental corporation of the Government of Canada created in 1978. It is funded directly by Parliament and reports to it through ISED. NSERC is the largest funder of science and engineering research in Canada. With funding from the Government of Canada, NSERC supports the research of over 41,000 students and professors at universities and colleges across the country with an annual budget of CAN$ 1.1 billion (Natural Science and Engineering Research Council of Canada (2020)).

NSERC is working towards six goals, namely to:

1. Foster a science and engineering culture in Canada

Making science and engineering mainstream; increasing interest, awareness, and appreciation of science as a way of experiencing, understanding, and enriching the world.

2. Launch the new generation

Mobilising Canada's future brain trust; enabling early-career scientists to launch independent research careers.

3. Build a diversified and competitive research base

Stimulating breakthrough research and research excellence; building, mobilising, and connecting expertise across populations, institutions, disciplines, regions, and sectors.

4. Strengthen the dynamic between discovery and innovation

Transforming the dynamic between discovery and innovation; deepening the interactions between colleges and universities, the private sector, governments, and civil society.

5. Go global

Securing Canada's access to global scientific and engineering knowledge and expertise and increasing participation in international research endeavours.

NSERC mentions thirteen research priority areas: Aerospace, Automotive, Environmental Science and Agriculture, Forestry and Wood, Products Research, Health and Related Life Sciences and Technologies, Information and Communications Technologies, Natural Resources and Energy, Northern Research, Manufacturing, Oil Sands and Heavy Oil, and Water-Related Research.

The largest funding theme is Environmental Science and Agriculture and Figure 7 illustrates reporting from 2019 on activities and outcomes in this area.

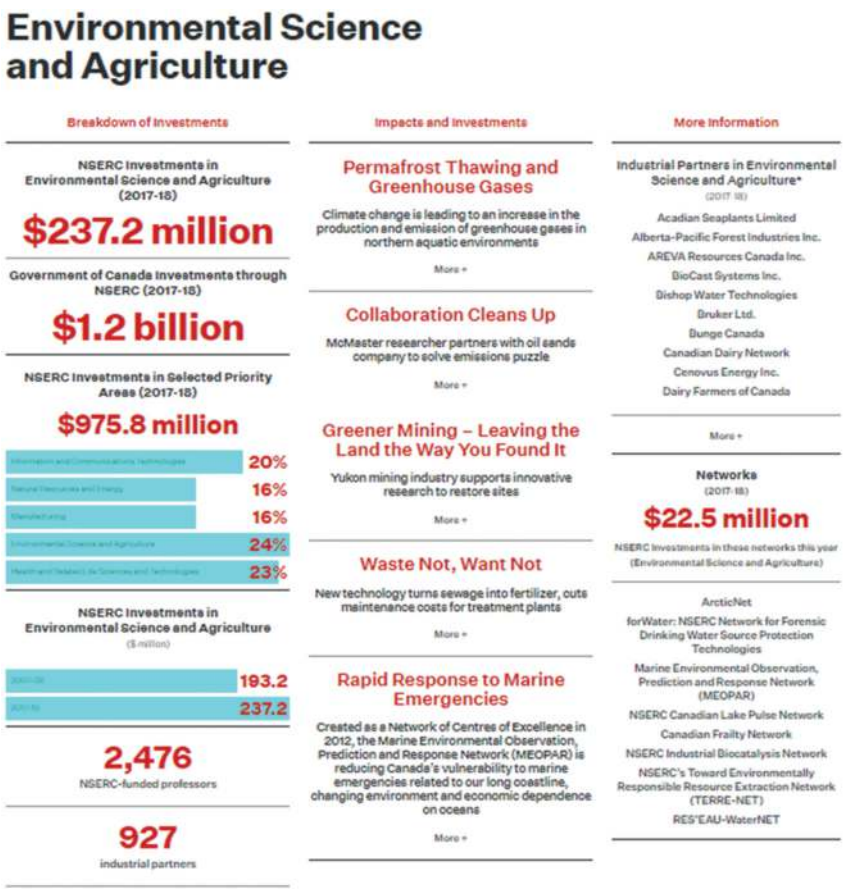

Figure 7: **Deep dive into NSERC's largest funding theme - Environmental Science and Agriculture. NSERC Reporting 2019**

New Frontiers in Research Fund (NFRF) (and legacy Networks of Centres for Excellence (NFC))

The Canada Research Coordinating Committee designed the New Frontiers in Research Fund (NFRF) following a comprehensive national consultation, which involved Canadian researchers, research administrators, stakeholders and the public. NFRF is administered by the Tri-Agency Institutional Programs Secretariat, which is housed within the Social Sciences and Humanities Research Council (SSHRC), on behalf of Canada's three research funding agencies: the Canadian Institutes of Health Research, the Natural Sciences and Engineering Research Council and SSHRC.

The fund also took over parts of previous activities by the Networks of Centres of Excellence (NCE). Since its creation, the NCE has funded 39 networks and centres through its suite of programmes, which aim to mobilise Canada's best research, development and entrepreneurial talent, and focus it on specific issues and strategic areas.

The fund will invest CAN$ 275 million over the next five years, beginning in the fiscal period 2018–19, and CAN$ 65 million ongoing, to fund international, interdisciplinary, fast-breaking and high-risk research.

NFRF is composed of three streams to support research (New Frontiers in Research Fund (2020)):

1. Exploration generates opportunities for Canada to build strength in high-risk, high-reward and interdisciplinary research;
2. Transformation provides large-scale support for Canada to build strength and leadership in interdisciplinary and transformative research; and
3. International enhances opportunities for Canadian researchers to participate in research with international partners.

National Research Council Canada (NRC) and NRC Industrial Research Assistance Program (NRC-IRAP)

The NRC is Canada's largest federal science, research and development organisation. It is an agency of the Government of Canada, reporting to Parliament through ISED, and is governed by a council of appointees drawn from its client community. The NRC invests in strategic R&D and partners with Canadian industry to take research impacts from the laboratory to the marketplace (National Research Council Canada (2020)).

The NRC comprises four integrated R&D divisions, each guided by advisory bodies composed of industry leaders. Under these four umbrella R&D divisions, NRC has fourteen integrated and consolidated research centres focused on key industry sectors. These research centres represent areas of strategic importance and economic value for Canada. Within each research centre, the NRC has a variety of programmes focused on addressing specific business-identified priorities and challenges through a unique offering of technical and advisory services, research facilities, licensing opportunities and programmes and partnership opportunities.

To complement this broad array of R&D capabilities, the NRC's *Industrial Research Assistance Program (NRC-IRAP)* brings together a diverse network of organisations, services and programmes to help Canadian SMEs develop and exploit technologies in the competitive, global knowledge economy. This makes NRC-IRAP Canada's leading innovation assistance programmes for Canadian SMEs, providing advice, connections, and funding for SMEs to increase their innovation capacity and take ideas to market. With an additional CAN$ 100 million in 2018–19 allocated through the 2018 budget, NRC-IRAP began to identify high-potential firms whose rapid growth could be furthered. To pinpoint "emerging winners" – firms with critical R&D projects that could transform the scale of their businesses, create next-generation products or reach new markets – NRC-IRAP tapped its network of *Industrial Technology Advisors (ITAs)*, drawing on their knowledge and years of project data. By the end of March 2019, NRC-IRAP had made larger-scale investments in 31 SMEs. Its goal is supporting 30 projects a year at CAN$ 1 million to CAN$ 3 million, and five a year at between CAN$ 3 million to CAN$ 10 million, thus giving potential market leaders an extra boost.

The Canadian International Innovation Program (CIIP) fosters and supports collaborative industrial research and development projects with high potential for commercialisation between Canada and partner countries. It also stimulates bilateral science and technology networking and matchmaking activities to further new partnerships and accelerate the commercialisation of research and development. The CIIP is a "seed fund", meaning that various other public and private sector participants are also encouraged to bring science and technology expertise and funds of their own to a bilateral relationship. Partner countries are Brazil, China, India, Israel, and South Korea. CIIP is a funding programme offered by Global Affairs Canada and is delivered in collaboration with the National Research Council of Canada Industrial Research Assistance Program (NRC-IRAP) for Brazil, China, India and South Korea. The programme is delivered by the Canada–Israel Industrial Research and Development Foundation (CIIRDF) for Israel.

Canada Foundation for Innovation (CFI)

The Canada Foundation for Innovation (CFI) is Canada's principal mechanism for funding the research infrastructure that universities, colleges, research hospitals and nonprofit research institutes require to conduct cutting-edge research and technology development. The Canada Foundation for Innovation (CFI) is a nonprofit corporation created by the Government of Canada under the authority of the Minister for Innovation, Science and Economic Development. The CFI makes financial contributions via six funds to Canada's universities, colleges, research hospitals and nonprofit research organisations to increase their capacity to carry out high-quality research. Since its creation in 1997, the CFI has ensured that Canadian researchers have the tools they need to push the frontiers of knowledge in all disciplines, and to contribute to the full spectrum of research – from discovery to technology development. The infrastructure funded by the CFI includes state-of-the-art equipment, laboratories, databases, specimens, scientific collections, computer hardware and software, communications linkages and buildings necessary to conduct leading-edge research.

The CFI funds up to 40% of a project's research infrastructure costs. This funding is then leveraged to attract the remaining investment from partners in the public, private and nonprofit sectors. Together, the CFI and its funding partners – provincial governments, research institutions and the private sector – invest nearly CAN$ 1 billion per year in the tools, equipment and facilities researchers use to create new knowledge, develop technologies, help companies innovate, and train the next generation of creative, talented and entrepreneurial researchers.

By 2017 the CFI had invested more than CAN$ 6.6 billion in close to 10,000 projects that span all disciplines and range in size and complexity from databases, electron microscopes and gene sequencers to large-scale digital networks, ocean research vessels and particle physics facilities.

Two major funds run by CFI are *The Innovation Fund and The Mayor Science Initiatives Fund.* The Innovation Fund makes a broad range of awards available for leading-edge research infrastructure across all disciplines and areas of research. The Major Science Initiatives Fund was designed to provide a systematic approach for evaluating and addressing the operations and maintenance (O&M) funding needs of such national research facilities as well as their scientific performance (Canada Foundation for Innovation (2020)).

Sustainable Development Technology Canada (SDTC)

A foundation created by the government (under ISED) to support Canadian companies with the potential to become world leaders in their efforts to develop and demonstrate new environmental technologies that address climate change, clean air, clean water and clean soil. The Board comprises private and not-for-profit sector leaders from across Canada with a broad range of experience and expertise. In addition to being accountable to its Board of Directors, SDTC is accountable to Parliament through the Minister of Innovation, Science and Economic Development Canada (ISED). The 2017 budget included an additional investment of CAN$ 400 million over five years to re-capitalise the SD Tech Fund. This CAN$ 400 million commitment is the single largest investment made by the Government of Canada since SDTC's inception in 2001. Since 2001, the Government of Canada has committed CAN$ 1.364 billion to SDTC.

Business Development Bank of Canada (BDC)

Federal development bank owned by the Government of Canada. Its mandate is to help create and develop Canadian businesses through financing, growth and transition capital, venture capital and advisory services, with a focus on SMEs. The Business Development Bank of Canada (BDC) is asked to fill gaps in the lending market by also focusing on the financial needs of small businesses that export or are in the knowledge-based industry, while continuing to support traditional sectors. The BDC's mandate includes other areas considered neglected by the private sector (Aboriginals, women and young entrepreneurs). (Business Development Bank of Canada (2020)).

Trade Commissioner Service (TCS) and CanExport Innovation

Part of the Ministry Global Affairs Canada, the Canadian Trade Commissioner Service (TCS) is a network of more than 1,000 trade professionals working in Canadian embassies, high commissions, and consulates located in 161 cities around the world and with offices across Canada. The role of the TCS is to promote the economic interests of Canada in the global marketplace. Some programmes target R&D and innovation in general. *CanExport Innovation* offers funding to support Innovators from Canadian organisations seeking foreign partners for the purpose of establishing a collaborative R&D agreement. Canadian innovators who aim to commercialise technology can access up to CAN$ 75,000 in funding to establish new R&D collaborations with foreign partners to co-develop, validate or adapt their technologies for commercialisation. The organisation must be one of the parties performing the R&D work resulting from the Contractual Agreement(s) and the R&D work must lead to the commercialisation of a Canadian technology within five years (Trade Commissioner Service (2020)).

Canadian Institute for Advanced Research (CIFAR)

CIFAR is a nonprofit organisation that brings together teams of top researchers from around the world to address important and complex questions. The aim is to be Canada's global research institute. It was founded in 1982 and is supported by individuals, foundations and corporations, as well as funding from the Government of Canada and the provinces of Quebec, British Columbia and Alberta. CIFAR receives funding from a blend of governments, partnerships (research organisations and universities), private sector (corporations, foundations and individuals) and investment income. CIFAR's community of fellows includes 20 Nobel laureates and more than 400 researchers ("CIFAR fellows ") from 22 countries. CIFAR's annual budget for 2019 was CAN$ 41M. In 2017, CIFAR was chosen to develop and lead the Pan-Canadian Artificial Intelligence Strategy (Canadian Institute for Advanced Research (2020)).

CIFAR and the Government of Canada accordingly announced a CAN$ 125 million five-year partnership to cement Canada's position as a world leader in AI by attracting, developing and retaining top research talent and promoting collaboration between Canada's main centres of AI expertise.

The Pan-Canadian AI Program includes four main elements, namely to: 1. Fund AI institutes in Canada's three major centres – Edmonton, Montreal and Toronto; 2. Fund and manage the Canada CIFAR Chairs in AI Program to support the recruitment and training of young researchers, both graduate students and postdoctoral fellows; 3. Implement a rich, global conversation on AI & Society to examine the social, economic and regulatory implications of AI, and inform the public and policy-makers; and 4. Develop a programme of national, collaborative activities to build on CIFAR's success, and ensure that Canada is positioned for sustained leadership in AI research and innovation.

Mitacs

CA nonprofit, national research organisation that, in partnership with Canadian academia, private industry and government, operates research and training programmes in fields related to industrial and social innovation. Mitacs was founded by Canadian mathematicians in 1999 and jointly funded by the federal and provincial Canadian governments, academic partners and research partners. The organisation, whose name originally was an acronym for "Mathematics of Information Technology and Complex Systems," first worked in the field of mathematical sciences and associated disciplines but has since expanded. Mitacs collaborates with 70 universities, 6,000 companies, and both federal and provincial government, and has 25 offices across Canada (Mitacs (2020)).

As of early 2019, Mitacs operates four main programs: *Accelerate, Elevate, Globalink,* and the *Canadian Science Policy Fellowship Program. Accelerate* is Mitac's flagship programme and has supported over 20,000 research internships with companies for graduate students and postdoctoral fellows since 2007. The basic idea is to provide work-integrated learning opportunities where Mitacs Accelerate International supports bilateral research collaborations between interns, universities, and industry partners, both in Canada and abroad. Interns at Canadian universities can undertake projects in Mitacs's partner countries, and interns from Mitacs's partner countries can undertake projects in Canada. *Elevate* is a two-year programme with the objective of providing postdoctoral fellows with professional and leadership development training while leading a long-term research project with a partner organisation. *Globalink* is an international programme supporting two-way research collaboration between Canada and research partners abroad. In 2019, Mitacs delivered over 2,000 international students and researchers across Canada. The Mitacs Globalink Research Award provides CAN$ 6,000 to senior undergraduate and graduate students, and postdoctoral fellows in Canada to conduct 12–24-week research projects at universities overseas.

Eligible countries and regions in the European Union are France, Germany, the United Kingdom, and Wallonie-Bruxelles, and travel is covered to other EU countries if projects are part of the Marie Skłodowska-Curie Actions (MSCA) RISE programme. The *Canadian Science Policy Fellowship Program* matches PhD-level researchers to government agencies to influence evidence-based policy-making.

Universities Canada

Universities Canada is a membership organisation providing university presidents with a unified voice for higher education, research and innovation. Universities Canada was established and operates under provincial government charters, and most Canadian universities are members. The organisation lobbies for Canadian universities at the federal level, provides a forum for university leaders to share ideas and address challenges in higher education, supports students by providing online information on university study, offers scholarships on behalf of private sector companies, and fosters collaboration among universities and governments, the private sector, communities and international partners (Universities Canada (2020)).

Council of Minister of Education (CMEC)

Founded in 1967, CMEC is a collective voice for Canada's Ministers of Education and Postsecondary Education. It provides leadership in education at pan-Canadian and international levels and contributes to the exercise of the exclusive jurisdiction of provinces and territories over education. Ministers of Education work through CMEC on a wide variety of activities, projects, and initiatives. The CMEC for example represents provinces and territories on education-related international bodies and participates in their activities; contributes to the fulfilment of Canada's international treaty obligations; provides a national clearing house and referral service to support the recognition and portability of educational and occupational qualifications; assesses the skills and competencies of Canadian students; develops and reports on education indicators; sponsors research in education-related statistics; administers Canada's national official-languages programs; and consults and acts on a variety of issues in early childhood learning and development, elementary-secondary education, post-secondary education, and adult learning and skills development (Council of Minister of Education (2020)).

CANARIE

Established in 1993, CANARIE is a nonprofit corporation, with the majority of its funding being provided by the Government of Canada. CANARIE and its twelve provincial and territorial partners form Canada's National Research and Education Network. This ultra-high-speed network connects Canada's researchers, educators and innovators to each other and to global data, technology, and colleagues. Beyond the network, CANARIE funds and promotes reusable research software tools and national research data management initiatives to accelerate discovery, provides identity management services to the academic community, and offers advanced networking and cloud resources to boost commercialisation in Canada's technology sector. Its mandate includes providing an internationally competitive ultra-high speed network for Canada's research, innovation and advanced education communities; developing, demonstrating and implementing next generation technologies; and assisting firms operating in Canada and Canadian institutions to advance innovation and commercialisation of products and services to bolster Canada's technology capabilities (CANARIE (2020)).

Provincial Level – Four Important Provinces

The research funding ecosystems of four provinces are mapped here: British Columbia, Alberta, Ontario and Quebec. These provinces are not only the largest of Canada's provinces geographically, but also the most populous – together they account for 86% of the country's population – and with the highest concentration of economic activity. Below, a background on the economy is followed by an overview of the provincial governance of research and innovation and some important actors in the funding ecosystem of each province.

British Columbia (B.C.)

IWith an estimated population of 5.1 million as of 2019 (about 2.5 million of whom in Greater Vancouver), British Columbia (B.C.) is Canada's third most populous province. Of the provinces, B.C. had the highest proportion of visible minorities, representing 27% of its population, with large influx from China, South Korea, South Asian countries, and Japan.

The B.C. economy is diverse, with service-producing industries accounting for the largest portion of the province's GDP. It is the terminus of two transcontinental railways, and the site of major marine cargo and passenger terminals. Its climate encourages outdoor recreation and tourism, though its economic mainstay has long been resource extraction, principally logging, farming, and mining. The largest section of service sector employment is in finance, insurance, real estate and corporate management; however, many non-metropolitan areas are still heavily reliant on resource extraction.

Matters related to science and innovation in the Government of B.C. are concentrated to the portfolios of the Minister of Advanced Education, Skills & Training and the Minister of Jobs, Economic Development and Competitiveness. The crown agency executing and coordinating the innovation ecosystem is called Innovate BC.

B.C.'s science, technology and research community is supported by so-called innovation organisations – industry associations, major research organisations, and post-secondary research.

Major research universities in B.C. are the University of British Colombia, Simon Fraser University, the University of Victoria, the University of Northern British Columbia, Thompson Rivers University, Royal Roads University, Emily Carr University of Art and Design, Kwantlen Polytechnic University, Vancouver Island University, the University of the Fraser Valley, and the British Columbia Institute of Technology.

The active strategy for research and innovation by the B.C. government is called the Technology and Innovation Policy Framework, which serves as a roadmap to identify our priorities and the outcomes for current investments. The strategy has four goals summarised as:

1. Growing globally competitive industry clusters across the province that support British Columbians;
2. Increasing diversity and participation in the innovation economy – including Indigenous Peoples and those living in rural areas;
3. Helping B.C. companies scale up, anchor and create good-paying jobs for British Columbians; and
4. Developing the talent pool to help grow the innovation economy and attract the right types of investment to B.C.

The following are some examples of major current B.C. Research and Innovation initiatives and actors (B.C. government (2020)).

Michael Smith Foundation for Health Research

The Michael Smith Foundation for Health Research is the provincial support agency for health research in British Columbia. Created by the province in 2001, the foundation works to build B.C.'s health research capacity by helping universities, health authorities and research organisations attract and train highly qualified health researchers. The foundation builds an environment in B.C. that supports research and focuses on building collaborations and partnerships between jurisdictions and across academic, health and government organisations. The Michael Smith Foundation for Health Research awards funding to health researchers and health research trainees, as well as to research institutions, research units and research networks, and it also seeks out partners for joint funding opportunities.

Genome BC

Genome BC is one of six Genome Canada centres. It invests in and manages large-scale genomics and proteomics research projects focused on strategic areas such as health, forestry, fisheries, agriculture, the environment and ethics. Some of Genome BC's partners include Genome Canada, the government of B.C., Western Economic Diversification Canada and the Michael Smith Foundation for Health Research. Genome BC collaborates with government, post-secondary institutions and industry to support the role of genomics in B.C.'s successful life sciences cluster. Since its establishment in 2000, Genome BC has received CAN$ 221.5 million from the Province of B.C. This funding helps Genome BC to invest in projects that advance research and technology in many areas, including cancer identification and treatment, organ transplants, forest management, bioenergy, fisheries management, agriculture crop quality, and the biodegradation of mining explosives.

Pacific Institute for Climate Solutions

The Pacific Institute for Climate Solutions is a collaborative research organisation created by the province in January 2008. The institute brings together the private sector, government and B.C.'s four research-intensive institutions (the University of Victoria, the University of British Columbia, Simon Fraser University and the University of Northern British Columbia) to develop climate change solutions and lead B.C. into a low-carbon economy. The institute's main functions are to understand the magnitude and patterns of climate change; evaluate its physical, economic and social implications; assess options and develop solutions; and communicate the issues to government, industry and the public. The province invested CAN$ 94.5 million in an endowment for the Pacific Institute for Climate Solutions. Hosted by the University of Victoria, the institute translates the knowledge and expertise of climate researchers into action for government, industry and the public, ensuring that B.C. remains a leader in climate action research and policy.

Natural Resources and Applied Sciences Endowment

The Natural Resources and Applied Sciences Endowment was established by the province to build research and development, advanced training, technology transfer and commercialisation capacity in B.C. Through the endowment, the province makes targeted investments in projects with potential for social, environmental and economic benefit to B.C., typically in natural resources, the applied sciences and engineering. The endowment's research team programme provides funding to teams of two or more permanent faculty at eligible post-secondary institutions. The private-sector collaborative programme provides funding to permanent faculty working on projects with private-sector collaborations.

The two programmes focus on innovative solutions to problems while anticipating possibilities for leverage from national and international funding sources. The Natural Resources and Applied Science Endowment is a CAN$ 50-million fund administered by the B.C. Innovation Council.

World Centre for Digital Media Education

In 2006, the province announced the creation of the World Centre for Digital Media Education and Canada's first graduate programme in digital media. The centre serves as both a physical and virtual network of resources, programmes, facilities and initiatives to fuel the innovation, development and commercialisation of digital media products in B.C. and Canada. The graduate programme leads to a professional master's degree in digital media, which is being delivered at the Great Northern Way Campus. The 20-month professional graduate degree is jointly awarded by the University of British Columbia, Simon Fraser University, the Emily Carr University of Art and Design, and the British Columbia Institute of Technology. Students obtain practical team-based experience through an industry-relevant curriculum and projects. Students also complete an internship to help prepare them for careers in the growing digital media industry. With CAN$ 40.5 million from the province, the centre supports economic diversification by capitalising on the province's position as Canada's largest digital media cluster.

BC Bioenergy Network

The BC Bioenergy Network is an industry-led association with a mandate to maximise the value of B.C.'s biomass resources, develop mission-driven bioenergy research projects, reduce greenhouse gas emissions, advance B.C.'s bioenergy sector, and lever funding to support bioenergy technology. With its large forested area, B.C. is positioned to be a leader in wood-to-energy bioenergy and other bioenergy technologies. The province's CAN$ 25-million contribution to establish the network is advancing B.C. research in solid wood residues, pulp and paper residues, harvesting and pelletising, agriculture residues, municipal wastewater, landfill waste and solid waste, and community heating electricity greenhouse systems.

Centre for Drug Research and Development

The Centre for Drug Research and Development promotes collaborations between researchers, post-secondary institutions and industry to help researchers commercialise their discoveries. Research is focused on projects in cancer, cardiopulmonary health, genetics, infection and immunity, inflammatory disease, metabolism, musculoskeletal problems, neurosciences and ageing. The centre is known for its commitment to commercialising medical products, research and development, training highly qualified personnel and attracting top investments to B.C.'s life sciences sector. By working with a network of universities, government agencies, healthcare organisations and the drug development industry, the Centre for Drug Research and Development encourages innovation and development. Funding totalling CAN$ 62 million from the provincial government is helping the centre to close the gap between primary research and new medicines.

Canadian Institute for Advanced Research

The Canadian Institute for Advanced Research is a private, nonprofit organisation that brings together top researchers from around the world to collaborate on innovative projects. It creates unique communities of expertise that attract leading researchers to Canada. Its aim is to advance Canada's research community while solving problems to the benefit of society.

Since 2002, the provincial government has provided CAN$ 12.1 million to the Canadian Institute for Advanced Research to support its projects, help it raise funds from other stakeholders and attract top researchers to B.C. As more researchers come to the province, the overall research capacity is strengthened, helping B.C. to stay at the edge of the knowledge economy.

Geoscience BC

Geoscience BC is an industry-led applied geosciences organisation. It identifies and funds applied geosciences projects, working in partnership with industry, post-secondary institutions, government, First Nations and communities. Through the delivery of new data, technology and ideas, Geoscience BC increases knowledge and promotes investment in mineral, oil and gas exploration in B.C. Since Geoscience BC was founded in 2005, the province has provided over CAN$ 55 million in funding to further develop geoscience technologies to support mineral exploration in B.C.

BC Tech Association

The BC Tech Association is a member-based industry association representing technology companies across the province, from start-ups to established businesses. It delivers programmes and services including professional development and networking to help members connect and promote their businesses.

Creative BC

As the independent agency responsible for promoting the development of creative industries in B.C., Creative BC provides a single point of access for industry programming, production support services, tax credit administration, international marketing and policy development.

DigiBC

DigiBC is the province's digital media and wireless technology association. It offers networking, mentoring, professional development and marketing services, connects business leaders with government, and helps the industry to attract, train and retain talent.

Discovery Parks

Discovery Parks is a private Canadian trust that builds research facilities for B.C. It has facilities on three post-secondary campuses, and its tenants are technology companies that originate from post-secondary research. Discovery Parks supports technology transfer and commercialisation, and re-invests and distributes its profits to post-secondary institutions.

LifeSciences BC

LifeSciences BC supports and represents the biotechnology, medical device and greater life sciences sector of B.C. It facilitates partnering and investment, builds relationships between industry, academia and government, and provides leadership, advocacy and promotion.

Vancouver Island Technology Park

The Vancouver Island Technology Park is a University of Victoria enterprise that provides physical infrastructure to facilitate the growth of technology on the Island. The park is a modern research and technology centre, housing clusters of fuel cell, new media, wireless, life sciences, ocean technology and ICT companies. It works to link provincial, national and international resources with growing technology companies by providing a leading-edge space.

B.C. Knowledge Development Fund

The B.C. Knowledge Development Fund is the B.C. government's major research infrastructure funding programme. The fund provides up to 40% toward the cost of a research project and is typically matched with federal funding through the Canada Foundation for Innovation. The programme ensures that research projects with the capacity for long-term economic and social benefits to the province receive the funds they need. Past recipients of the B.C. Knowledge Development Fund include NEPTUNE Canada, the Blusson Spinal Cord Centre and the Interdisciplinary Research in the Mathematical and Computational Sciences Centre. Since 2001, the Government of B.C. has invested over CAN$ 520 million in research infrastructure through the fund.

BCNET

BCNET is a nonprofit organisation that provides high-speed optical network capabilities, often called advanced networks, to B.C.'s higher education and research institutions. Advanced networks support experimental and collaborative efforts in education and research being conducted across the province and around the world.

Centre for Drug Research and Development

The Centre for Drug Research and Development helps to advance medical research into clinical developments and commercialisation. Its goal is to build a collaborative research infrastructure and increase research and development capacity in B.C.

FPInnovations

FPInnovations is a not-for-profit organisation that creates scientific solutions to support the Canadian forest sector's global competitiveness and responds to the priority needs of its industry members and government partners.

Ocean Networks Canada

Ocean Networks Canada operates the NEPTUNE and VENUS cabled ocean observatories for the advancement of science and the benefit of Canada. These observatories collect data on physical, chemical, biological, and geological aspects of the ocean over long periods, supporting research on complex Earth processes.

Pacific Institute for Climate Solutions

The Pacific Institute for Climate Solutions is a collaboration between the University of Victoria, the University of B.C., Simon Fraser University and the University of Northern B.C. It was launched by the Government of B.C. to develop innovative climate change solutions.

TRIUMF

TRIUMF is Canada's national laboratory for nuclear and particle physics research and related sciences. Located on the University of British Columbia campus in Vancouver, TRIUMF is owned and operated as a joint venture by a consortium of seven Canadian universities. It provides scientific and engineering leadership, bringing together interdisciplinary talent, technical resources and commercial partners.

Alberta

Alberta is Canada's fourth most populous province with an estimated population of 4.1 million. Calgary and Edmonton are Alberta's two metropolitan areas, both of which have populations exceeding one million. Alberta's population is on average the youngest of all the provinces; it has the smallest proportion of seniors among the provinces and one of the highest population shares of children, further contributing to Alberta's young and growing population. Alberta is the third most diverse province in terms of visible minorities after British Columbia and Ontario.

In the 2010s, Alberta's economy was one of the strongest in the world, supported by the burgeoning petroleum industry and to a lesser extent, agriculture and technology. In 2013, Alberta's per capita GDP exceeded that of the United States, Norway, or Switzerland, and was the highest of any province in Canada. While petroleum revenue has been declining, agriculture constitutes a significant position in the province's economy and Alberta beef has a healthy worldwide market. Nearly half of all Canadian beef is produced in Alberta. With concerted effort and support from the provincial government, several high-tech industries were founded in Alberta, notably patents related to interactive liquid-crystal display systems.

The research and innovation portfolio in the Alberta Government centres on the Ministry for Advanced Education, and the Ministry for Economic Development, Trade and Tourism. Since 2016, the Government of Alberta has tasked Alberta Innovates as the research and innovation corporation to execute three main R&I strategic priorities: 1.) Embracing the digital future; 2.) Enhancing Alberta's knowledge workforce; and 3.) Developing emerging technologies.

The current provincial strategy is called the Alberta Research and Innovation Framework (ARIF) with a number of targets set up towards 2030. These can be summarised as:

- Economic diversification and job creation – catalysing growth and diversification of the economy
- Environmental stewardship and climate leadership – facilitating anticipation and mitigation of environmental impacts
- Effective resource management – enabling cost-effective discovery, development and production of natural resources
- Engaged individuals and communities for a healthy Alberta – enhancing the health and wellbeing of Albertans

Major Universities in Alberta are the University of Alberta, the University of Calgary, and the University of Lethbridge.

Below follow descriptions of some of the major current Alberta Research and Innovation investments and actors (Alberta government (2020)).

Alberta Research and Innovation Advisory Committee

The Committee provides strategic advice and recommendations to the Government of Alberta through the Minister of Economic Development, Trade and Tourism on research opportunities, emerging technologies and policy direction to enhance innovation. The matters covered include: identifying leading research areas and innovation policies that will support the diversification of Alberta's economy; providing the Minister with regular reviews and reports on the performance of Alberta's research and innovation system; making recommendations to increase Alberta's competitiveness; exploring, gathering and synthesising information on best practices in other jurisdictions; utilising benchmarking strategies to assess the status and progress of Alberta's research and innovation system; and identifying emerging global science, research, technology and innovation trends of greatest impact to Alberta.

Campus Alberta Innovation Program

The Campus Alberta Innovation Program (CAIP) facilitates the attraction and recruitment of new research leaders to Alberta and was launched in 2011 as a one-time investment under the Strategic Research Initiatives (SRI) to facilitate the attraction and recruitment of leading-edge faculty and research personnel such as graduate students and postdoctoral fellows. It focused on four key areas of existing or emerging research and innovation priority: Energy and environment; Neuroscience/prions; Food and nutrition; and Water.

GreenSTEM

GreenSTEM is a pan-Albertan entrepreneurial pilot programme to provide funding and support for technology company creation and high-tech entrepreneurial development to Science, Technology, Engineering, and Math (STEM) Masters and Ph.D. graduates. The two-year program enables entrepreneurship and provides a two-year commercialisation runway for "deep technology" companies involved in science-based innovation.

Major Innovation Fund

The Major Innovation Fund (MIF) supports transformative research and innovation investments of strategic and commercial interest as part of the Alberta Research and Innovation Framework (ARIF) to attract and retain top talent and support industries and local businesses. These projects will secure and strengthen Alberta's competitive position in research and technology development, and attract talent and additional investment by highlighting unique-to-Alberta initiatives. Post-secondary institutions will have the opportunity to submit proposals and assemble teams to build research excellence and innovative capacity in the following areas: Antimicrobial resistance; Autonomous systems; Building and construction innovations; Food from Smart Agriculture; Indigenous, rural and remote water management; and Quantum computing.

Research Capacity Program

The Research Capacity Program (RCP) supports Campus Alberta institutions and researchers in acquiring small equipment and large research infrastructure. The RCP is a competitive funding programme designed to build capacity in Alberta's post-secondary institutions and attract, retain, and develop researchers undertaking transformative and applied research programmes. The RCP includes the following competition streams: College-Industry Innovation (CII) supports applied research infrastructure in colleges/polytechnics; Cyberinfrastructure (CYB) supports the infrastructure needs of computationally and data-intensive research; Research Infrastructure (RI) supports large research infrastructure for research teams of up to 10 principle users; and Small Equipment Grants (SEG) supports research equipment for individual researchers or small teams.

Talent Advisory Council on Technology

Convening leaders of industry, post-secondary institutions and government to share insights and advice to grow Alberta's tech sector, the Talent Advisory Council on Technology brings together leaders of industry, post-secondary institutions, students and labour to help guide Alberta's future in the technology field. Technology is rapidly affecting key sectors of the economy, including healthcare, agri-food, energy, commerce and the service industries. Alberta therefore continues to develop a highly skilled, talented and adaptive workforce to diversify its economy and improve its global competitiveness. The council aims to provide government with guidance and advice in order to increase access to a variety of educational opportunities and technology skills development programs.

Genome Alberta

Genome Alberta is a publicly funded nonprofit corporation that initiates, funds and manages genomics research and partnerships. They strive to be the leading source of information and administration related to genomics, metabolomics, bioinformatics and biotech research in Alberta.

Alberta Machine Intelligence Institute

The Alberta Machine Intelligence Institute performs advanced research in the fields of artificial intelligence and machine learning, and helps businesses to change the way they think about data and decision-making to drive growth.

Ontario

Located in Central Canada, Ontario is Canada's most populous province, with 38% of the country's population. It is home to the nation's capital city, Ottawa, and the nation's most populous city, Toronto.

An abundance of natural resources, excellent transportation links to the North American heartland, and the inland Great Lakes making ocean access possible via container ships have all contributed to making manufacturing the principal industry of the province. Mining and the forest products industry, notably pulp and paper, are vital to the economy of Northern Ontario. Ontario surpassed Michigan in car production in 2004, with major plants by Chrysler, GM, Honda, Ford and Toyota. Toronto is the centre of Canada's financial services and banking industry. Neighbouring cities are home to product distribution, IT centres, and manufacturing industries. The information technology sector is important, particularly in the Silicon Valley North section of Ottawa, home to Canada's largest technology park. IT is also important in the Waterloo Region, where the headquarters of BlackBerry is located.

The Ontario Government's Ministry of Economic Development, Job Creation and Trade is at the core of the research and innovation portfolio. The Ministry handles research and development funding, business advisory services, career exploration opportunities and business start-up programmes for youth, and skills development, and markets Ontario to potential international business investors.

Major universities in Ontario are the University of Toronto, Queen's University, Lakehead University and Laurentian University.

Interestingly, Ontario lacks a comprehensive research and innovation strategy. The 2019 provincial budget shows a broad theme of increasing innovation through improving the province's business environment. The government's innovation plan revolves around lowering corporate taxes and increasing innovation incentives, reducing red tape and regulations, and lowering energy costs. The Ontario government has also developed several industry-specific innovation strategies. One example is Driving Prosperity, a CAN$ 40 M commitment over three years to strengthening innovation and competitiveness in the auto sector. Driving Prosperity aims to strengthen Ontario's position in auto-related advanced manufacturing and mobility technologies. The plan includes an Automotive Modernization Program to foster innovation in parts assembly, enhancement for Ontario's Autonomous Vehicle Innovation Network, and the promotion of leadership in new technologies such as hydrogen fuel cells.

Notable initiatives and provincial actors include (Ontario government (2020)):

Ontario Research Fund: Research Excellence

The Ontario Research Fund – Research Excellence provides research institutions with funding to support the operational costs of major projects of strategic value to the province. The fund provides up to one third of the total value of a project, with the remaining two-thirds coming from a combination of private sector and institutional contributions.

Ontario Research Fund: Research Infrastructure

The Ontario Research Fund – Research Infrastructure provides research institutions with funding to help support infrastructure needs, such as modern facilities and equipment. This can be large infrastructure (costs of building/renovating and equipping facilities to conduct collaborative academic research), small infrastructure (costs of acquiring/renewing research equipment (e.g., specimens, scientific collections, computer software, information databases), and specifically help to cover the costs of building, renovating and equipping research facilities to promote college-industry partnerships.

International research projects with China and Israel

Funding for research projects with partners in China or Israel. The Ontario–China Research and Innovation Fund was created in partnership with the government of Ontario and the Ministry of Science and Technology of China to support research collaboration projects. This year, Ontario and China are each investing CAN$ 1 million to provide CAN$ 2 million in overall funding. In collaboration with the Government of Israel, funding is available for research in bio-economy and clean technologies, advanced health technologies, pharmaceutical research and manufacturing, and digital media and information and communication technologies. The funding amount is up to 50% of total costs (maximum of CAN$ 300,000). Israeli partners are also eligible to receive funding through the Government of the State of Israel.

Early Researcher Awards

The Early Researcher Awards programme gives funding to new researchers working at publicly funded Ontario research institutions to build a research team. The Early Researcher Awards programme is a discretionary, non-entitlement programme that encourages applications from all disciplines. Each award to a leading researcher is a maximum of CAN$ 100,000 and must be matched by an additional CAN$ 50,000 from the researcher's institution and/or a partner organisation. The funds are to be used over a period of five years to fund eligible expenses for a research team of undergraduates, graduate students, postdoctoral fellows, research assistants, associates, and technicians. In addition, up to CAN$ 40,000 is provided by the Ministry to the institution for indirect costs.

Ontario Network of Entrepreneurs (ONE)

ONE is a collaborative network of organisations across Ontario funded by the provincial government and designed to help entrepreneurs, businesses and researchers commercialise their ideas. It provides a comprehensive suite of programmes and services spanning the full commercialisation continuum from idea to market.

Quebec

Quebec is the second-most populous province of Canada, after Ontario. It is the only one to have a predominantly French-speaking population, with French as the sole provincial official language. Most inhabitants live in urban areas near the Saint Lawrence River between Montreal and Quebec City, the capital. Quebec independence debates have played a large role in the politics of the province. Parti Québécois governments held referendums on sovereignty in 1980 and 1995. Although neither passed, the 1995 referendum saw the highest voter turnout in Quebec history, at over 93%, and only failed by less than 1%. In 2006, the House of Commons of Canada passed a symbolic motion recognising the "Québécois as a nation within a united Canada."

While the province's substantial natural resources have long been the mainstay of its economy, sectors of the knowledge economy such as aerospace, information and communication technologies, biotechnology, and the pharmaceutical industry also play leading roles. These industries have all contributed to helping Quebec become an economically influential province within Canada, second only to Ontario in economic output.

Quebec's economy has undergone tremendous changes over the last decade. The abundance of natural resources gives Quebec an advantageous position on the world market. Quebec stands out particularly in the mining sector, ranking among the top ten areas to do business in mining, as well as its forest resources. Firmly grounded in the knowledge economy, Quebec has one of the highest growth rates of GDP in Canada. The knowledge sector represents about 31% of Quebec's GDP. Quebec is experiencing faster growth of its R&D spending than other Canadian provinces and is also a major player in several leading-edge industries including aerospace, information technologies and software and multimedia. Approximately 52% of Canadian companies in these sectors are based in Quebec, mainly in Montreal and Quebec City. There are currently approximately 115 telecommunications companies established in the province, such as Motorola and Ericsson. Approximately 60% of the production of the Canadian aerospace industry are from Quebec.

The Government Quebec's research and innovation portfolio is managed by Ministère de l'Économie et de l'Innovation. This Ministry is currently executing the 2017–2022 Québec Research and Innovation Strategy with the aim of positioning Québec among the top ten research and innovation leaders in the OECD by 2022.

Whereas the Ontario government's innovation approach is more focused on providing incentives to drive business innovation and trade, Quebec's government takes a more active approach through government spending in targeted innovative sectors such as life science and aerospace – both areas with specific strategies in play.

Quebec's government announced CAN$ 15 million for the "Technoclimat" program, which offers funding for the development of technological innovation in the areas of energy efficiency, renewables, bioenergy, and GHG emission reduction. Quebec's budget also has a "Stimulating Innovation to Create the Jobs of Tomorrow" component that provides nearly CAN$ 709 million by 2023–24 to boost innovation. This funding is divided between artificial intelligence (AI) (CAN$ 329 million) and other innovative areas (CAN$ 380 million).

Regarding AI, the government has committed CAN$ 12.5 million towards AI training for students, CAN$ 38 million toward attracting AI researchers, CAN$ 65 million towards encouraging business to use AI, CAN$ 34.5 towards increasing Quebec's computational power (by improving AI-related infrastructure), CAN$ 79.3 million towards backing technologies that support AI (technologies such as electronic design, photonic solutions and semiconductors) and CAN$ 100 million towards supporting AI research.

The CAN$ 380 million towards other innovative areas includes CAN$ 50 million towards forest industry innovation, CAN$ 7.5 million in genomics research, and CAN$ 2.1 million in industrial bioprocess research by 2023–24. CAN$ 320 million will be dedicated to upgrading infrastructure in Montreal, Quebec City, Gatineau and other regions to develop strategic sites for innovative businesses.

Major Universities in Quebec are the University of Montreal, McGill University, Laval University and Concordia University.

Notable initiatives and provincial actors in research and innovation include (Quebec government (2020)):

Fonds de recherche du Quebec

In 2011, a new bill restructured Quebec's three research funding agencies. The primary aim was to ensure strong management for the support and promotion of Québécois research and thereby improve Québec's position in the global science arena, foster and enhance synergies and partnerships between different research sectors, and improve the visibility of government research in Québec and elsewhere, all under a single umbrella. Although now grouped together under the banner "Fonds de recherche du Québec," the three funds have retained their individual missions: Fonds de recherche – Nature et Technologies supports natural sciences, mathematical sciences, and engineering; Fonds de recherche – Santé supports health, including basic, clinical, and epidemiological research, research in public health, and research in health services; and Fonds de recherche – Société et Culture supports social sciences and humanities as well as education, management, arts, and literature.

Quartier de l'innovation

The Ontario Research Fund – Research Infrastructure provides research institutions with funding to help support infrastructure needs, such as modern facilities and equipment. This can be large infrastructure (costs of building/renovating and equipping facilities to conduct collaborative academic research), small infrastructure (costs of acquiring/renewing research equipment (e.g., specimens, scientific collections, computer software, information databases), and specifically help to cover the costs of building, renovating and equipping research facilities to promote college-industry partnerships.

Innovation Quebec

Focus on commercialisation and development of technological innovations and strategic support. Founded in 2012, Innovation Quebec is a nonprofit organisation specialised in consulting services and commercialisation of technological innovations.

To accomplish its mission, Innovation Québec provides strategic intelligence and supports private and public companies to develop their technologies acquisition or commercialisation strategies. To this end, Innovation Québec offers companies information, services and advice to speed up business innovation.

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STINT, The Swedish Foundation for International Cooperation in Research and Higher Education, was set up by the Swedish Government in 1994 with the mission to internationalise Swedish higher education and research.

STINT promotes knowledge and competence development within internationalisation and invests in internationalisation projects proposed by researchers, educators and leaderships at Swedish universities.

STINT promotes internationalisation as an instrument to:

- Enhance the quality of research and higher education
- Increase the competitiveness of universities
- Strengthen the attractiveness of Swedish universities

STINT's mission is to encourage renewal within internationalisation through new collaboration forms and new partners. For example, STINT invests in young researchers' and teachers' international collaborations. Moreover, STINT's ambition is to be a pioneer in establishing strategic cooperation with emerging countries in research and higher education.

STINT
Stiftelsen för internationalisering av
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